U. S. ARMY MISSILE COMMAND

REDSTONE ARSENAL, ALABAMA

GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

REVISED MARCH 1983

U.S. ARMY MISSILE COMMAND

Redstone Arsenal, Alabama 35809

U. S. ARMY MISSILE COMMAND

REDSTONE ARSENAL, ALABAMA

GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

PUBLISHED OCTOBER 1981

REVISED SEPTEMBER 1982

REVISED MARCH 1983

Prepared by: Morris W Schroder
MORRIS W. SCHRODER
General Engineer
DRSMI-KLC

Reviewed by:
For JAMES A. CORBETT
Chief, Master Planning, Construction and Environmental Office

Approval Recommended by Paul W Hancock
PAUL W. HANCOCK
Facilities Engineer
Redstone Arsenal Support Activity

Approved by:
ROBERT A. PARSONS
Colonel, AD
Deputy Post Commander

GROUNDWATER AND SURFACE WATER
MONITORING PROGRAM

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The U.S. Environmental Protection Agency promulgated rules and regulations pertaining to Hazardous Waste Management Systems in the Federal Register Vol. 45 No. 98 on Monday, May 19, 1980. Part VII, "Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," requires the implementation of a groundwater monitoring program by November 19, 1981. The monitoring program must be capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility. This must be accomplished by first establishing the existing quality of groundwater and then by monitoring to determine if degradation of the groundwater is taking place.

This plan includes a ground water monitoring program which describes the location of monitoring wells, analytical parameters to be monitored, and the quality control procedures for conducting a technically sound project. A sampling and analysis program for monitoring the surface water quality in the various streams crossing Redstone Arsenal is also discussed.

This plan also includes general information describing the topography and geology at Redstone Arsenal, the DDT Waste landfill site and the construction methods for the DDT landfill. A description of the ground water monitoring wells located at RSA is also included.

SECTION I. GENERAL INFORMATION

1. Regional Hydrogeology

The regional hydrogeology of RSA is detailed extensively in the document titled "Environmental Geology and Hydrology of Huntsville and Madison County, Alabama" published in 1975 by the Geological Survey of Alabama. Copies may be purchased from: Publication Sales Geological Survey of Alabama, P.O. Drawer O, University of Alabama 35486, phone (205) 759-5721. The brief descriptions that follow may generally be supplemented by the above referenced document.

a. Environmental Settings

(1) Madison County

Madison County is in the central part of the most northern tier of Alabama counties. Its northern boundary is the state of Tennessee at approximately 35° North latitude. Its southern boundary is formed by the Tennessee River and its tributary, the Paint Rock River. The county covers about 803 square miles (514,000 acres) including the Wheeler Reservoir and the Tennessee Valley Authority (TVA) property.

(2) Redstone Arsenal, Alabama

Redstone Arsenal is located in the southwestern portion of Madison County with its southern border formed by the Tennessee River. It is roughly rectangular, being about 6 miles wide and 10 miles long and occupying 60.4 square miles (38,659 acres). The installation is adjacent to the southwest limits of Huntsville; other cities within a 100-mile radius include Birmingham, Chattanooga, and Nashville.

Of the Installation's total acreage, 36,818 acres are controlled by Department of the Army (DA) and 1,841 acres are leased on a long-term basis to the George C. Marshall Space Flight Center, National Aeronautics and Space Administration (NASA). In addition, 2,900 acres are owned by the Tennessee Valley Authority (TVA) but are made available to DA by a use permit and about 4,100 acres of the Wheeler National Wildlife Refuge lie within the Redstone Arsenal boundary which are also utilized by DA according to the provisions of a permit.

Woodlands occupy about 15,500 acres, approximately 9,200 acres are leased for agricultural use (primarily grazing), and more than 10,200 acres are classified as mission, improved, unimproved, and water areas. The improved category encompasses 3,245 acres including lawns (760 acres), athletic fields (27 acres), golf course (175 acres), parade grounds (14 acres), cemeteries (20 acres), other improved turf (1,389 acres), and road shoulders (850 acres). Included in the category of unimproved grounds are roads, streets, and railroads (809 acres); buildings (600 acres), ammunition storage (2,400 acres), flight ranges and safety zones (4,337 acres), demolition area (670 acres), and contaminated areas (150 acres).

b. Climate

(1) Temperatures

The climate of Redstone Arsenal is mild and temperate. Freezing temperatures seldom continue for more than 48 hours, and summer temperatures are not excessive. The average annual temperature for Madison County is 62°F, the average summer temperature is 77°F, and the average winter temperature is 47°F.

(2) Rainfall

The average annual snowfall is 3 inches and the average rainfall is 48 inches (March is highest with 5.6 inches and October is lowest with 2.7 inches of rain). The growing season averages 208 days. Usually the last frost in the spring is no later than 5 April and the first frost in the fall is about 31 October. Floods are most common from mid-December to mid-April and extensive floods are infrequent. Prolonged droughts are rare but moderately dry conditions generally prevail throughout autumn.

(3) Winds

The prevailing winds are from the southeast; however, winds from the north and south are also common. Average wind velocity is highest in winter and lowest in summer.

c. Regional topography, geology and soils data

(1) Physiography

The major physiographic areas of Madison County are a remnant of the Cumberland Plateau in the eastern third of the country, the northern gray lands and central red lands of the Highland Rim of the Interior Low Plateau, and the Old General Alluvium that occupies a large part of the lower areas of the Tennessee River Valley.

(2) Soils

The soils of the county differ greatly in color, texture, consistence, acidity, fertility, relief, drainage, stoniness, depth to bedrock, and permeability. Color varies from nearly white to gray or yellow, and from brown to red; they are mostly cherty silt loams, silt loams, and silty clay loams. Undulating and rolling relief predominate. Nearly level soils cover about 30 percent of the county occuring along streams on the bottom lands or in gentle depressions in red lands. Well-drained soils, adequate for all crops, occupy about half of Madison County, and 64 percent of the county is free of stones, especially the alluvial plains and red lands. Bottom lands, alluvial plains, and red lands are generally most productive.

(3) Drainage and Topography

Madison County is drained by the Tennessee River and surface drainage is generally dendritic except on the smoother general alluvial plains in the southeastern portion. Throughout much of the red lands belt, a number of shallow depressions or sinks occur that do not have surface drainage outlets.

Poor soil drainage is confined to some of the nearly level areas on old stream terraces, or on old general alluvium, and to the young alluvium on bottom lands along larger streams.

(4) Geology

The rocks of Madison County are sedimentary in origin consisting primarily of many varieties of limestone, sandstone, and some acid shales. Geologically, the oldest rocks are in the Chickamauga limestone formation of the Ordovician system. A small area of this highly fossiliferous rock is exposed in northwestern Madison County and another in the north-central part.

Fort Payne chert overlies the Chickamauga limestone, is the lowest member of the Mississippian system, and is weathered into soils mainly in the northwestern part of the county. Tuscumbia limestone includes both the Warsaw and St. Louis limestones of the Mississippian system, is the surface formation for more than half of the county, and extends westward from the mountains eastern border to northwest quarter.

d. Water Resources

(1) Surface Water

Surface drainage on the reservation is generally in a southerly direction into the Tennessee River mainly via the three streams as described below:

(a) Huntsville Spring Branch flows for about 1.2 miles through the Arsenal before merging with McDonald Creek (a tributary) and eventually forms Wheeler Reservior (5 miles in length from the point of merging) to become a tributary of the lower reaches of Indian Creek. Huntsville Spring Branch drains a total area of about 86 square miles and flows from the City of Huntsville in a southwesterly direction, meandering more than 13 miles across the installation before emptying Indian Creek. The area of Redstone Arsenal drained by this creek is 5,000 acres of which 84 acres are roofs and surfaced areas. The average slope of this drainage is 3 percent.

(b) McDonald Creek enters the northern most section of the Arsenal and flows for about 1.7 miles to the southeast leaving the Installation for a distance of .6 miles. The stream re-enters the reservation and flows for approximately 3.3 miles before merging with Huntsville Spring Branch. McDonald Creek drains about 6,000 acres of the Installation of which 388 acres are roofs and surfaced areas.

(c) Indian Creek flows north to south through the western portion of the Arsenal for about 6 miles before merging with its major tributary on Redstone Arsenal (Huntsville Spring Branch). Indian Creek then twists its way for another 4 miles before leaving the reservation boundary. Indian Creek is a tributary of the Tennessee River and drains an area of 143 square miles within the Installation boundaries. The average slope of this stream is 5 percent. Within its drainage are 294 acres of roofed and surfaced areas.

(2) Ground Water

In the southern part of Madison County (the location of Redstone Arsenal) water encountered in wells penetrating solution cavities generally rises above the point at which it is first encountered. The limestone or chert overlying the solution cavity system is under hydrostatic pressure caused by the weight of the water at higher levels in the solution channels. The water table is highest during February and March in response to recharge from heavy winter rains. During this period water in most all solution cavities is under hydrostatic pressure. The water table is generally lowest during October and November and during this period the water in many of the cavities nearest to the recharge area is under water table conditions.

The general direction of movement of ground water within the intricate system of fracture and solution cavities is to the south. Three springs are found on the Installation where the land surface is eroded to or below a water-bearing cavity. Williams Spring flows into Indian Creek near Martin Road at approximately 4.5 cubic feet per second. Flow rates have not been measured for Gowan Spring near Tupelo Pond and for an unnamed spring on the east side of the Installation at the site of an old home.

(3) Water Supply and Usage

Potable water is supplied at Redstone Arsenal by Water Treatment Plant Nos. 1 and 3 (water drawn from the Tennessee River) and three wells serving remote test ranges.

Water Treatment Plant No. 1 treats and distributes both domestic (potable) and industrial (process) water. Water Treatment Plant No. 3 obtains its intake water from the industrial water supply system and completes the treatment for industrial distribution. Water Treatment Plant No. 2 is maintained in standby and has been used to provide water when WTP-1 was out of order in January 1981.

2. Description of DDT Waste Soils Landfill.

a. Physical layout of site, areal extent, local topography and drainage are shown on Figure I-1. Further information is given in Appendix A.

b. Design specifications of site to include liners and covers are described in Appendix A.

c. Nature and Volume of Wastes Deposited at Site

Material deposited is soil, rubble and dredge ditch material that is contaminated with DDT. Pit #6 held approximately 4000 CY yards of waste material, Pit #5 - 5000 CY yards, Pit #4 - 1000 CY yards, Total approximately 10,000 CU yards.

d. Method of Disposal, When Wastes were Deposited, Rate of Fill, Application of Cover

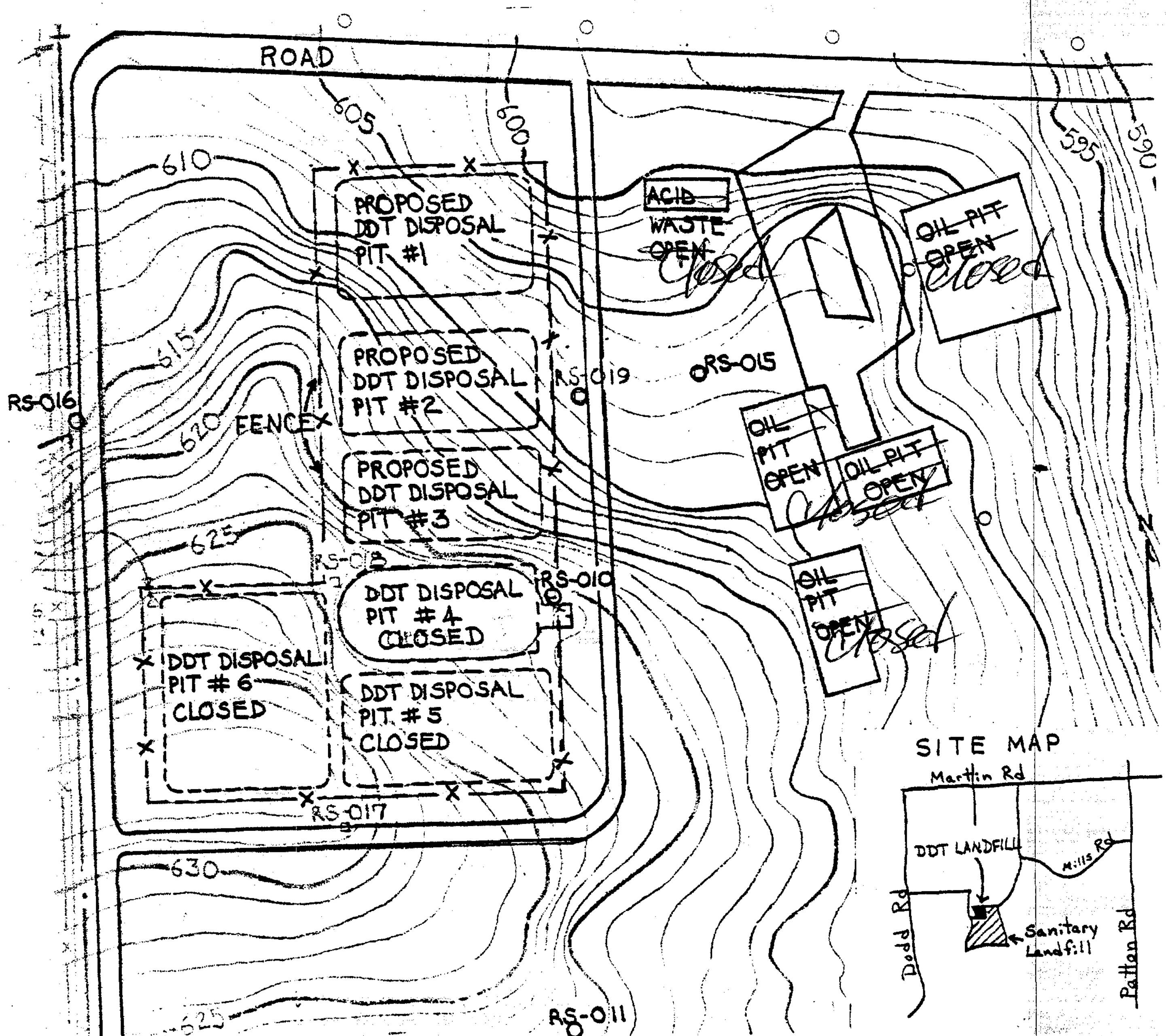


FIGURE I-1

DDT LANDFILL

Pit #6 opened November 1979. Waste material came from cleanup around the Olin DDT Manufacturing Site, Old Basement area and area south of the plant sites to the double culvert area. Initial dredging of the ditch at the double culvert area was also deposited in this pit. The material was hauled by dump truck and unloaded in the pit. A bulldozer then pushed and packed the material in the pit. This pit was filled by January of 1980. The top cap was then put on but final cover was not applied until June of 1980.

Pit #5 was dug in late November and early December 1979. The dredged materials from the DDT Waste ditch were deposited in this pit along with some of the exposed DDT from the landfill areas. This pit was capped in May 1980 and final cover was applied in June 1980.

Pit #4 was dug in June 1980 and residues from the remainder of the landfill sites and soils from around the old DDT bagging plant at the Olin Plant were deposited in this pit. Residues from the Basement cleanup of the John Powell Chemical Co. (pesticide manufacturer), Building 5681, were also placed in this pit. The sump from the Calgon DDT filtration plant was cleaned in July 1982 and the sediments were placed in pit #4. The pit was closed and capped in August 1982.

e. Surface Soils Description

(1) Soils type in the area of the DDT Waste Landfill are of the Decatur - Cumberland - Abernathy Association as described in the referenced document of paragraph 1 above. These soils are generally well drained, fertile and thick over limestone bedrock. These soils are found on nearly level to gently rolling terrain.

(2) Permiability under the site varied from 1×10^{-7} to 3×10^{-8} K(CM/Sec) as recorded in the test report by Testing Incorporated of Decatur, Alabama, 29 August 1978 and 8 January 1979.

f. The geological regime underlying the site is Tuscumbia Limestone.

g. At the present time, the vegetation at the site is Fescue grass in seeded areas and weeds elsewhere. The landfill is surrounded by pine and hardwood forests.

h. Description of the construction of existing monitoring wells and their depths are attached as Figure I-2 and Table I-1.

3. Local Ground Water Use

Redstone Arsenal utilizes the Tennessee River for all of its industrial water supply and most of its potable water supply. Three wells located in the northern portion of Redstone Arsenal supply potable water to the Visitor Center on Martin Road., Test Area 6 and Test Area 3 respectively. These wells are located up stream from any of the sanitary fill areas or hazardous waste disposal site.

4. Environmental Relationships

The DDT Hazardous Waste Landfill is located in the south central portion of Redstone Arsenal in a controlled access sanitary landfill area. Installation boundaries are about 3 miles away east-west and 5 miles away north-south. Huntsville, Alabama, is located to the north and east of RSA and Triana, Alabama is located to the southwest of RSA. Industrial areas, small subdivisions and the Huntsville Jetport are located along the west boundaries of RSA. The Tennessee River borders the entire southern boundary of RSA.

MONITOR WELL INSTALLATION

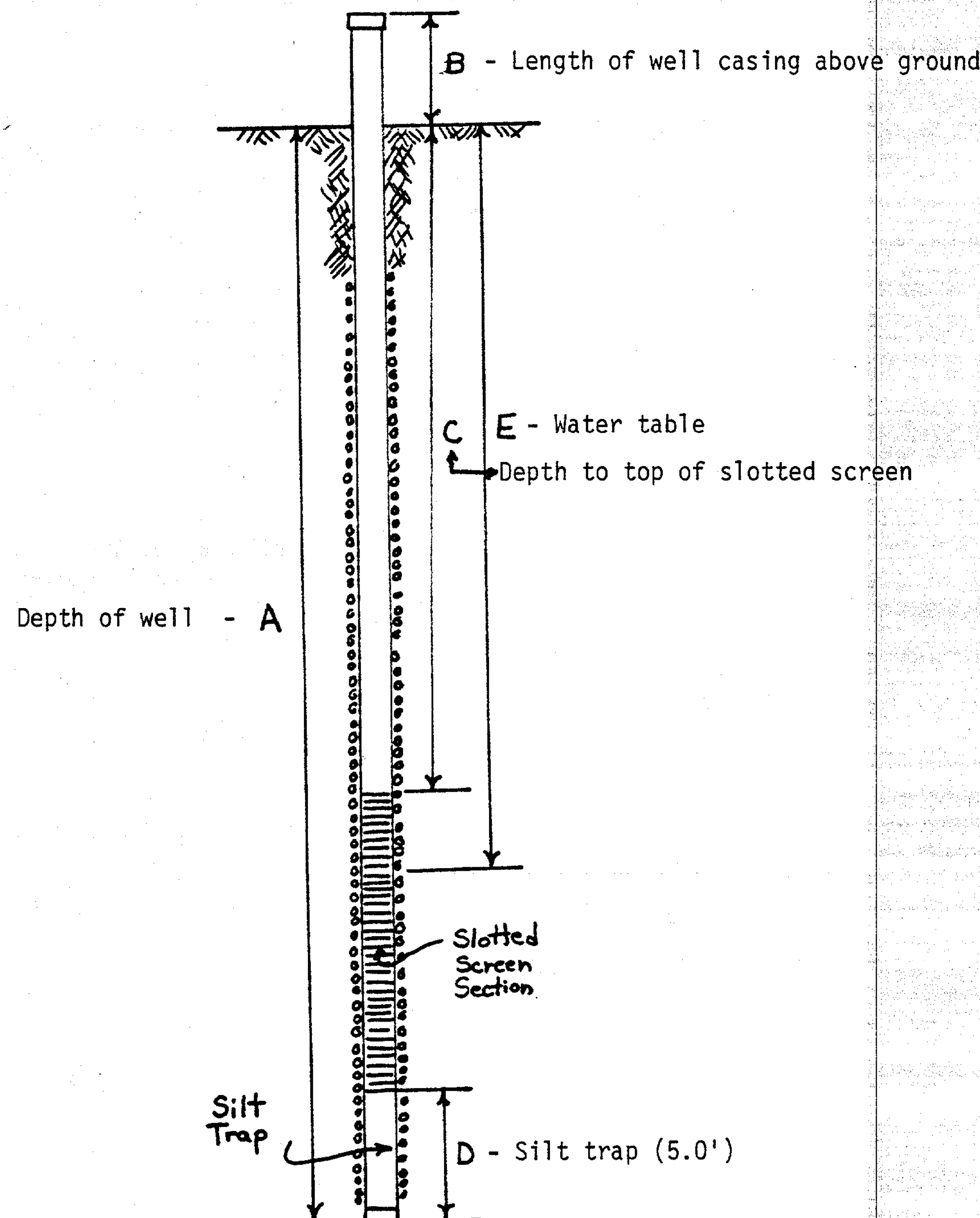


FIGURE I-2

TABLE I-1: Water Table Depths (Centimeters), Redstone Arsenal Wells

SITE ID	DEPTH GWS (CM)	DATE GWS	SITE ID	DEPTH GWS (CM)	DATE GWS	SITE ID	DEPTH GWS (CM)	DATE GWS
RS010	1753	08/08/1978	RS030	436	11/17/1978	RS041	52	02/14/1980
RS010	1676	09/12/1979	RS030	341	09/11/1979	RS042	91	09/29/1979
RS010	1536	02/08/1980	RS030	372	02/04/1980	RS042	180	01/14/1980
RS011	771	09/12/1979	RS031	1076	12/07/1978	RS042	52	02/14/1980
RS011	652	02/08/1980	RS031	936	09/11/1979	RS043	131	11/08/1979
RS015	823	11/15/1978	RS031	841	02/08/1980	RS043	152	01/14/1980
RS015	716	09/12/1979	RS032	594	12/06/1978	RS043	119	02/14/1980
RS015	527	02/08/1980	RS032	533	09/11/1979	RS044	1829	10/09/1979
RS016	1122	11/15/1978	RS032	427	02/05/1980	RS044	1923	01/15/1980
RS016	1152	09/12/1979	RS033	771	12/06/1978	RS044	1740	02/14/1980
RS016	1015	02/08/1980	RS033	752	09/11/1979	RS045	360	10/29/1979
RS020	64	11/28/1978	RS033	558	02/05/1980	RS045	860	01/21/1980
RS020	91	09/11/1979	RS034	67	12/12/1978	RS046	393	10/10/1979
RS020	61	02/04/1980	RS034	79	09/12/1979	RS046	564	01/21/1980
RS021	238	11/28/1978	RS034	43	02/05/1980	RS046	445	02/14/1980
RS021	223	09/11/1979	RS035	454	12/12/1978	RS047	1725	11/08/1979
RS021	210	02/04/1980	RS035	243	09/11/1979	RS047	1832	01/21/1980
RS022	235	11/13/1978	RS035	186	02/05/1980	RS048	204	09/22/1979
RS023	116	11/30/1978	RS036	265	12/12/1978	RS048	183	01/07/1980
RS024	247	11/28/1978	RS036	55	09/12/1979	RS048	192	02/14/1980
RS025	55	11/30/1978	RS036	0	02/05/1980	RS049	137	09/29/1979
RS025	91	09/11/1979	RS037	418	12/12/1978	RS049	213	01/07/1980
RS025	46	02/04/1980	RS037	320	09/11/1979	RS049	91	02/14/1980
RS026	140	11/20/1978	RS037	216	02/04/1980	RS050	491	09/22/1979
RS026	146	09/11/1979	RS038	326	12/12/1978	RS050	674	01/07/1980
RS026	143	02/04/1980	RS038	223	09/11/1979	RS050	518	02/14/1980
RS027	30	11/30/1978	RS038	27	02/05/1980	RS051	914	11/12/1979
RS027	98	09/11/1979	RS039	549	12/12/1978	RS051	1500	01/25/1980
RS027	30	02/04/1980	RS039	503	09/12/1979	RS051	323	02/14/1980
RS028	162	11/22/1978	RS039	411	02/05/1980	RS052	905	09/21/1979
RS028	292	09/10/1979	RS040	64	09/29/1979	RS052	771	01/21/1980
RS028	180	02/04/1980	RS040	158	01/14/1980	RS052	668	02/14/1980
RS029	305	11/20/1978	RS040	49	02/14/1980	RS053	820	09/21/1979
RS029	293	09/10/1979	RS041	64	09/29/1979	RS053	1064	01/07/1980
RS029	354	02/04/1980	RS041	91	01/15/1980	RS053	491	02/14/1980

TABLE I-1: Water Table Depths (Centimeters), Redstone Arsenal Wells (Continued)

SITE ID	DEPTH GWS (CM)	DATE GWS	SITE ID	DEPTH GWS (CM)	DATE GWS	SITE ID	DEPTH GWS (CM)	DATE GWS
RS054	896	09/19/1979	RS060	482	10/09/1979	RS067	1439	01/21/1980
RS054	1167	01/07/1980	RS060	530	01/14/1980	RS067	1378	02/14/1980
RS054	625	02/14/1980	RS060	399	02/14/1980	RS068	183	09/26/1979
RS055	1006	11/12/1979	RS061	2170	10/05/1979	RS068	241	01/08/1980
RS055	1106	01/07/1980	RS061	2118	01/25/1980	RS068	189	02/14/1980
RS055	716	02/14/1980	RS061	2024	02/14/1980	RS069	98	09/26/1979
RS056	511	10/04/1979	RS062	1201	10/09/1979	RS069	101	01/21/1980
RS056	570	01/15/1980	RS062	1216	01/15/1980	RS069	107	02/14/1980
RS056	378	02/14/1980	RS062	1143	02/14/1980	RS070	209	09/28/1979
RS057	1033	10/04/1979	RS064	1515	10/01/1979	RS070	363	01/08/1980
RS057	1195	01/15/1980	RS064	64	01/25/1980	RS070	250	02/14/1980
RS057	1088	02/14/1980	RS064	1445	02/14/1980	RS071	104	09/28/1979
RS058	869	10/05/1979	RS065	363	10/08/1979	RS071	238	01/25/1980
RS058	1021	01/15/1980	RS065	314	01/08/1980	RS071	67	02/14/1980
RS058	847	02/14/1980	RS065	253	02/14/1980	RS077	608	07/20/1981
RS059	94	10/08/1979	RS066	445	10/03/1979	RS078	459	07/20/1981
RS059	34	01/14/1980	RS066	561	01/08/1980	RS079	1150	07/20/1981
RS059	27	02/14/1980	RS066	472	02/14/1980	RS080	227	07/20/1981

SECTION II - GROUNDWATER MONITORING

1. Sampling and Analysis Requirements

a. Federal Requirements

The United States Environmental Protection Agency Rules and Regulations for Hazardous Waste contain specific requirements for groundwater monitoring. The detailed requirements are described in the Federal Register 40 CFR Part 265, Subpart F. The regulation provides for a groundwater monitoring system including wells upgradient and downgradient from landfill sites. The U.S. Army has established a number of monitoring wells at various locations at Redstone Arsenal for this purpose.

b. Parameters for Monitoring

In accordance wih 40 CFR Part 265.92, the initial background concentrations must be established for one year on a quarterly basis for "Parameters Characterizing the Suitability of the Groundwater as a Drinking Water Supply" (Parameters listed in Table II-1), "Parameters Establishing Groundwater Quality" (Parameters listed in Table II-2), and "Parameters Used as Indicator of Groundwater Contamination" (Parameters listed in Table II-3). Also during the first year at least four replicated measurements must be obtained for each sample for the "Parameters Used as Indicators of Groundwater Contamination" for the upgradient wells outlined in part 265.91.

c. Frequency of Monitoring

After the first year, all monitoring wells must be sampled and analyzed annually for the parameters of ground-water quality (Table II-2) and semi-annually for the parameters of groundwater contamination (Table II-3), four replicates required).

d. Recording of Ground Water Surface

Elevation of the groundwater surface at each monitoring well must be determined each time a sample is obtained.

e. Assessment Program

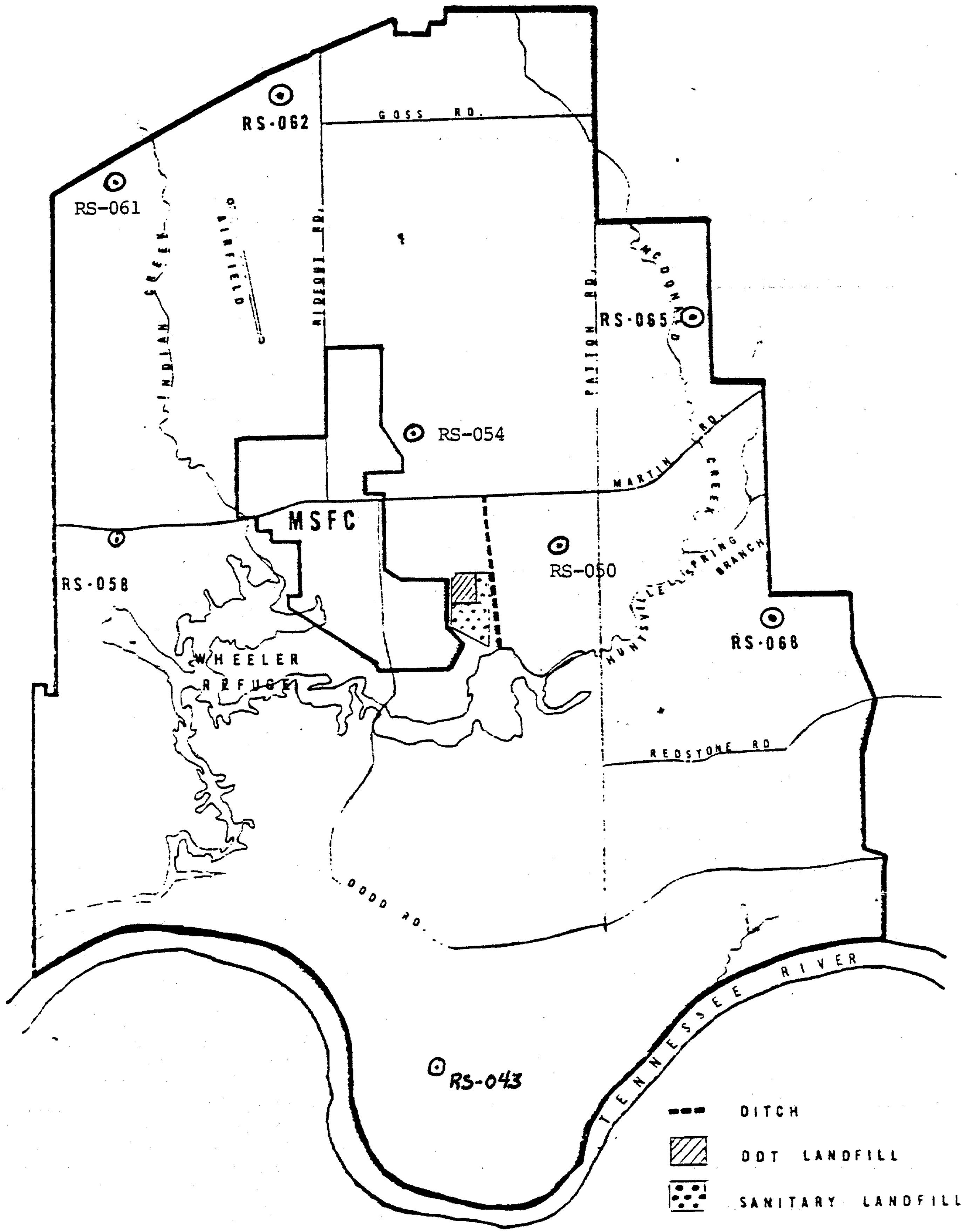
If monitoring results indicate a Leachate problem, the State of Alabama Department of Environmental Management (ADEM) and the US Army Environmental Hygiene Agency (USAEHA) will be consulted. If necessary an assessment program as described in 40 CFR 265.93 will be instituted.

2. Selection of Monitoring Wells

a. Background Monitoring

The U.S. Army has drilled and developed a series of two-inch diameter and four-inch diameter wells around the perimeter of the RSA facility and at selected locations throughout the facility. Groundwater flow in Madison County, Alabama, including RSA, is generally in a north to south direction. Therefore, wells along the northern perimeter will be used as the upgradient monitoring wells. Well RS-061 is located in the northwest section of RSA, Well RS-062 in the northern section and Well RS-065 in the northeastern section. In addition, Well RS-058, on the western perimeter, Well RS-068 on the eastern perimeter, and Well RS-043 in the southern area will be included for background information. Figure II-1 shows the locations of these wells. In addition to the parameters listed in Table II-1, II-2, and II-3, the wells will also be analyzed for DDT and PCBs.

FIGURE II - 1 BACKGROUND MONITORING WELLS



b. Arsenic Monitoring

Wells RS-050 and RS-054 are located near the old organic arsenic material storage areas. Although the areas are not a waste disposal or landfill site, groundwater monitoring is recommended. Wells RS-050 and RS-054 will be monitored for groundwater quality parameters listed in Table II-2, plus arsenic on a semi-annual basis. The locations of these wells are shown in Figure II-1.

c. DDT Landfill Monitoring

The U.S. Army has constructed special pits, lined with packed clay as a DDT waste soils landfill site on RSA. Wells RS-010, RS-011, RS-015, RS-016, RS-081 and RS-082 surround the landfill site (See Figure II-2). These wells will be monitored as down gradient wells in accordance with 40 CFR 265.92 as discussed in paragraph 1 of this section. Well RS 062 will be utilized as the up-gradient well for this monitoring. The details on this monitoring program are given in the Closure-Post Closure Plan (CPCP) for DDT Hazardous Waste Soils Landfill, Redstone Arsenal, Alabama. Parameters to be monitored are listed in Table II-2 and II-3 plus DDTR and PCBs.

d. Sanitary Landfill Monitoring

Groundwater monitoring is conducted in accordance with the Alabama Solid Waste Management Regulations Section 4-163 (Groundwater Resources). Four wells (RS-077, 078, 079 and 080) located on the southern perimeter of RSA's Sanitary Landfill will be monitored initially by the State of Alabama on a quarterly basis. Well RS-077 is an upgradient well and Wells 078, 079 and 080 are downgradient (Figure II-2). Thereafter, the groundwater in these wells will be monitored semi-annually in accordance with requirements set forth by the Alabama Department of Public Health. Parameters set forth by the State of Alabama in the permit to operate a sanitary landfill for Redstone Arsenal are found in Table II-4. These parameters will be monitored in March and September of each year beginning in September 1982 and continuing through the life of the permit (5 years).

e. Summary

A summary of groundwater analyses to be performed, after the initial year quarterly sampling (with replicates) is completed, and is presented in Table II-5.

TABLE II-1

PARAMETERS CHARACTERIZING THE SUITABILITY OF THE GROUNDWATER AS A DRINKING WATER SUPPLY
40 CFR Part 265.92 (b) (1)

Arsenic	Nitrate (as N)	2, 4-D
Barium	Selenium	2,4,5-TP Silvex
Cadmium	Silver	Radium
Chromium	Endrin	Gross Alpha
Fluoride	Lindane	Gross Beta
Lead	Methoxychlor	Turbidity
Mercury	Toxaphene	Coliform Bacteria

TABLE II-2

PARAMETERS ESTABLISHING GROUNDWATER QUALITY
40 CFR Part 265.92 (b) (2)

Chloride	Phenols
Iron	Sodium
Manganese	Sulfate

TABLE II-3

PARAMETERS USED AS INDICATORS OF GROUNDWATER CONTAMINATION
40 CFR Part 265.92 (b) (3)

pH	Total Organic Carbon
Specific Conductance	Total Organic Halogen

TABLE II-4

Parameters to be monitored in groundwater wells at the Redstone Arsenal Sanitary Landfill.

Specific Conductance	Chloride
pH	Iron
DDT	Phenols

TABLE II-5

GROUND WATER SAMPLING AND ANALYSIS SUMMARY

WELL NO.	FREQUENCY/YR	TABLE OF ANALYSIS	TOTAL SAMPLES	TOTAL ANALYSES
RS 043, 058, 061 062, 065, 068, 010, 011, ~~016~~, 015 081, 082, 083, 084	1	II-2	~~12~~ 13	78
RS 050 and 054	1	II-2 plus Arsenic	2	14
RS 010, 011, ~~016~~, 015, 062 081, 082, 083, 084	2	II-3 (four replicates required) plus DDT and PCB's	~~14~~ 16	256
RS 077, 078, 079, 080, 085	2	II-4	~~8~~ 12	60
	TOTAL		36	408

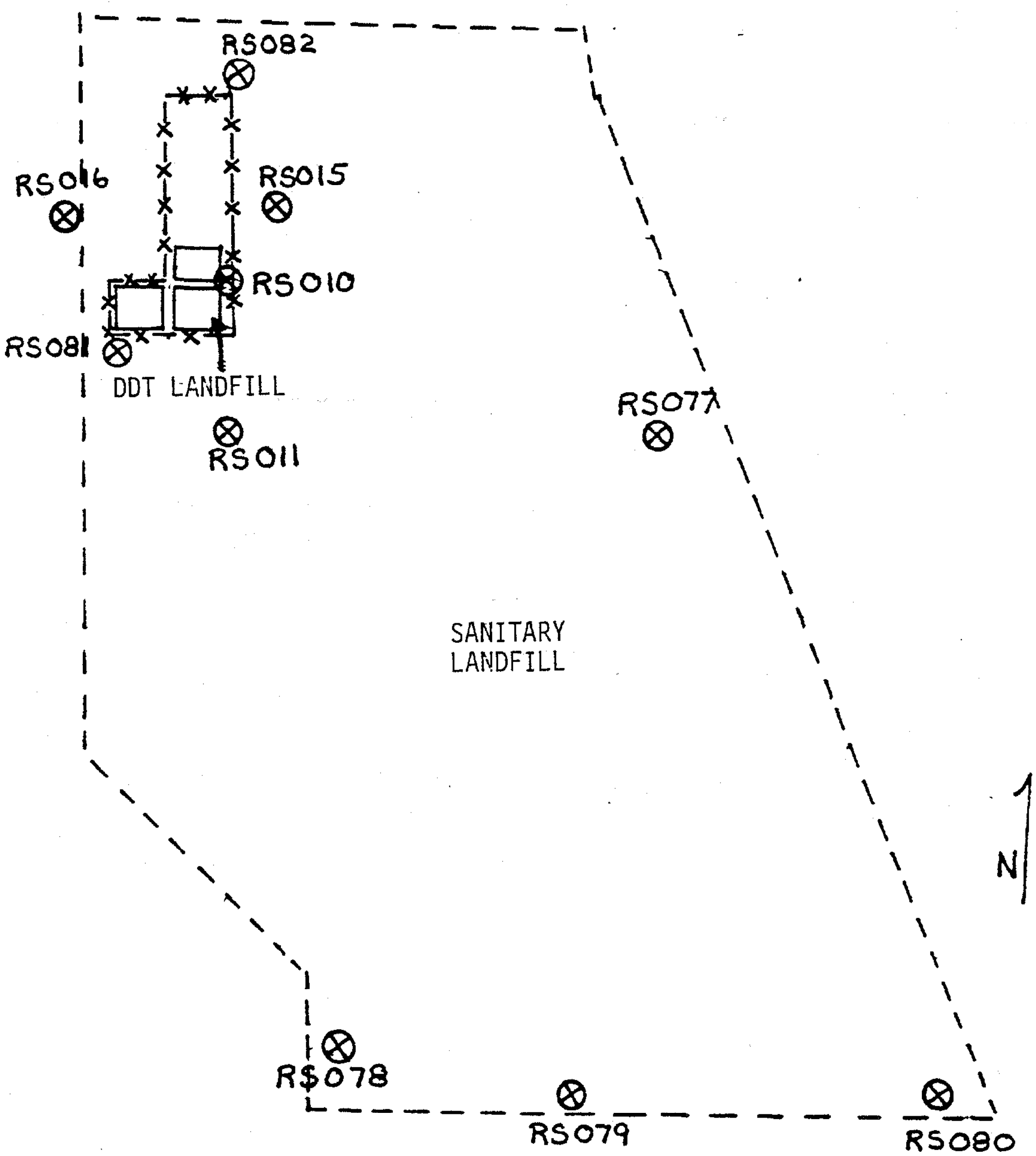


FIGURE II-2
Location of Monitoring Wells at
the DDT and Sanitary Landfills

SECTION III - SURFACE WATER MONITORING

1. Streams

a. Major Streams

Three major streams cross Redstone Arsenal prior to discharging into the Tennessee River. The water quality of the three streams is affected by a variety of point source and non-point source effluents on RSA. Indian Creek enters RSA in the northwest section and flows in a southerly direction. Indian Creek becomes a slow flowing backwater of Wheeler Lake and merges with Huntsville Spring Branch before its confluence with the Tennessee River. McDonald Creek enters RSA at the northern boundary of RSA and flows in a south to southeast direction and discharges into Huntsville Spring Branch. Redstone Arsenal Sewage Treatment Plants #1, #3 and #4 discharge from the force main into the Tennessee River. McDonald Creek also flows adjacent to an abandoned landfill area just prior to entering Huntsville Spring Branch. The effluent from a City of Huntsville sanitary treatment plan comprises the majority of the dry weather flow of Huntsville Spring Branch before it enters the eastern boundary of RSA. Huntsville Spring Branch flows through a large swamp area, merges with McDonald Creek and then joins Indian Creek in a backwater of Wheeler Reservoir before leaving the southwest corner of RSA.

b. Swamp Areas

It is obvious from the large amount of swamp area on RSA property that groundwater contributes significantly to the quality and quantity of water in the creeks crossing or originating on RSA property. Because of the inseparability of surface and groundwaters on RSA, surface water quality monitoring has been included in this plan. Table III-1 presents a list of surface monitoring locations. Surface points 1-8 will be monitored on a monthly basis for parameters in Table III-2. Surface points 1-13 will be monitored quarterly for parameters in Table III-3 and III-4 and annually for parameters in Tables III-2, III-3 and III-4.

2. Sanitary Treatment Plants

The U.S. Army operates three (3) treatment plants for handling domestic wastes for Redstone Arsenal. The treatment plants primarily treat sanitary wastes. Due to some cross connection, spill, etc., some industrial wastes may also be treated. Therefore, it is proposed to analyze the outfall from each of the treatment plants at least one time after they are hooked to the force main for the 129 priority pollutants.

3. Summary

Sampling locations, frequency of sampling and analysis parameters for wells and surface water locations are summarized in Table III-5.

TABLE III-1

LIST OF SURFACE WATER MONITORING LOCATIONS

SR - 1	Indian Creek entering Redstone Arsenal
SR - 2	McDonald Creek entering Redstone Arsenal
SR - 3	McDonald Creek above junction of McDonald Creek and Huntsville Spring Branch
SR - 4	Huntsville Spring Branch just above junction with McDonald Creek
SR - 5	Indian Creek at Martin Road
SR - 6	Huntsville Spring Branch at Patton Road
SR - 7	Huntsville Spring Branch at Dodd Road
SR - 8	Indian Creek at Centerline Road
SR - 9	Tributary to Tennessee River in the vicinity of the Demolition Area
SR - 10	Tributary to the Tennessee River south of the Igloo Area
SR - 11	East boundary ditch at Dodd Road, Gate 2
SR - 12	Tributary to the Tennessee River in southeastern part of Redstone Arsenal
SR - 13	The Big Ditch on the East Side of the Sanitary Landfill at the entrance to Wheeler Wildlife Refuge

TABLE III - 2

CHEMICAL AND BIOLOGICAL ANALYSIS FOR MONTHLY SURFACE WATER MONITORING AT POINTS 1-8

pH	Dissolved Oxygen
Biochemical Oxygen Demand	Specific Conductance
Turbidity	Total Alkalinity
	Temperature
	% Saturation Dissolved Oxygen

TABLE III - 3

CHEMICAL AND BIOLOGICAL ANALYSIS FOR QUARTERLY SURFACE WATER MONITORING AT POINTS 1-13

To be analyzed quarterly

Fecal Coliform	Cadmium
DDT	Chromium
PCB	Lead

TABLE III - 4

CHEMICAL AND BIOLOGICAL ANALYSIS FOR ANNUAL SURFACE WATER MONITORING AT POINTS 1-13

Phenols	Lindane
Sulfate	Methoxychlor
Nitrate Nitrogen	2, 4-D
Iron	2, 4, 5-TP Silvex
Manganese	Cyanide
Sodium	Oil and Grease
Arsenic	Total Phosphorus
Mercury	Fluoride
Selenium	
Endrin	

TABLE III - 5

SURFACE WATER SAMPLING AND ANALYSIS SUMMARY

LOCATION	FREQUENCY/YR	TABLES OF ANALYSIS	TOTAL SAMPLES
Surface Water Locations SR-1 through SR-8	12	III-2	96
Surface Water Locations SR-1 through SR-13	4	III-3	52
Surface Water Locations SR-1 through SR-13	1	III-4	13
Common Outfall at Tennessee River	1	129 Priority Pollutants	1
		TOTALS	162

SECTION IV - QUALITY CONTROL

Analytical laboratory results, whether they are utilized as background data or as an essential ingredient in a decision making process, have far reaching consequences. Therefore, the validity and reliability of analytical data is of utmost importance.

A "Quality Assurance Plan and Procedures Manual for Water Quality Studies" will be prepared for these water quality projects, and will be used for the QA program at RSA. Performance evaluation will be provided by analysis of split samples and unknown quality evaluation samples.

Shewhart type precision and accuracy control charts (X-R Charts), X = order, R = accuracy, will be used to evaluate the validity of results obtained on a routine basis. These X-R charts will be established using previous data for the analysis of the same type samples with the same skill level analyst. For parameters not having X-R charts, duplicates of the first 15-20 samples will be used to prepare new charts.

Calibration curves will be prepared for each parameter that requires a curve. The least-squares best fit line for a minimum of four (4) standards will be used to prepare the curve. Standard deviation in the concentration will be calculated from the deviation in the slope, y-intercept, and y-values. One or more standards will be analyzed with each set of samples. Duplicates will be routinely analyzed and the duplicate values should lie within two (2) standard deviations of the mean of the duplicates. Duplicates for analyses which do not require calibration curves, i.e., titrations and gravimetric analysis, will be plotted directly on the precision control charts.

Equipment and analytical instruments will be operated and calibrated according to manufacturer's recommendations. Polystyrene film color standards, calibration gases, thermometers, and other items necessary for instrument calibration validity will be utilized.

Representatives of samples collected in the field will be collected as duplicates. The duplicates will be treated as separate samples throughout the sample handling, transportation, and analysis procedures. Ten percent of the samples will be spiked at twice the expected concentrations. The range of the duplicate results indicates the validity of the results obtained from the samples. The percent recovery of the spikes indicates the accuracy of the results.

Proper handling of data begins in the field at the time the sample is taken. The sample must be properly identified by marking on the container with a waterproof magic marker. The following information will be recorded directly on the sample container label at the time of sampling.

a. Sample location number
b. Date
c. Preservative added
d. Any information about the sample pertinent to the laboratory analyst

At the time of sampling the sample will be logged into a field notebook. The following information will be recorded about the sampling.

a. Sample location number
b. Sampling time and date
c. Sample depth
d. Sample type (composite or grab)
e. Pertinent weather information
f. Any miscellaneous observations that might affect results
g. Personnel involved

The field notebook must be a bound waterproof book with consecutively numbered pages that serves as a permanent record of the sampling trip. All entries will be made in the book with a waterproof ink pen.

Upon receipt of the sample in the laboratory, the sample will be logged in the sample logbook by transference of information given on the sample label. Date of receipt and the parameters to be analyzed will be recorded. The date of completion of analyses will be recorded at the time the final analytical results are reviewed by the Project Manager.

Documentation of analytical data includes permanent recording of the data in meaningful exact terms and reporting them in proper form for future interpretation and use. To reduce errors in manipulation of numbers, information transposition will be kept to a minimum.

A permanently-bound notebook will be used with consecutively numbered pages to record data. The assigned notebook will be used until it is filled in chronological order. All entries will be recorded in the notebook with waterproof ink. Each page will be organized in an orderly manner and enough detail recorded about the analyses performed so that another analyst can pick up the notebook and understand the information. The following information will be recorded as a minimum:

a. Date and project
b. Type analysis and method used
c. Description of any variation in method from what is standard
d. Weighings
e. Sample size and dilutions
f. Absorbances, percent transmission, or other instrument readings
g. Titrations
h. Standardization and calibration data
i. Calculations and resultant data as reported
j. Pertinent observations
k. Personnel involved

Laboratory notebooks will be periodically checked by the Laboratory Supervisor for completeness and accuracy of calculations.

GENERAL LABORATORY PROCEDURES AND ANALYSIS METHODS

Personnel will be proficient in the use of analytical methods contained in Standard Methods for the Examination of Water and Wastewater, 14th edition, 1975; Methods for Chemical Analysis of Water and Wastes, 1974 USEPA publication; Methods for Chemical Analysis of Water and Wastes, 1979 USEPA publication; Microbiological Methods for Monitoring Industrial Wastewater, 1973 USEPA publication.

Generally accepted good laboratory practices will be used for cleaning glassware and other equipment. All glassware will be washed in a warm detergent solution, thoroughly rinsed with tap water, and then rinsed with deionized water. Additional specific cleaning procedures will be used for analyses with more demanding cleanliness requirements. The additional procedures include acid washing, solvent rinsing, etc., as well as segregation of glassware for use in specific analyses such as nitrate, mercury, lead, and oil and grease.

Safety equipment and supplies will be provided and good safety practices encouraged by management. Safety provisions will be incorporated in the facility's design. These include proper lighting, air supply, vent hoods, safety shower, and emergency exit door in the lab. Other safety equipment should include fire extinguishers, eye wash bottle, safety shields, and other equipment normally found in a safety conscious laboratory.

APPENDIX A

DESCRIPTION OF DDT

WASTE LANDFILL

1. Construction of the DDT hazardous waste landfill.

A DDT hazardous waste landfill was constructed with discrete cells as shown in Figure I-1. As each cell was constructed, the excavated material was laid back in such a manner as to permit emplacement of the least permeable clay along the bottom, then compacted to form a low permeability bottom. After each cell was filled it was covered with compacted clay and topsoil. A minimum roadway and drainage ditch were constructed around the landfill and a cattle-type three-strand barbed wire fence with two 16' gates installed. Warning signs were fastened to the fence. To avoid bumping or otherwise disturbing the monitor wells adjacent to the landfill, sturdy posts (4" wood or 3" steel pipe) were placed around the wells in such a manner as to stop, on impact, any vehicle used in the area.

2. Filling the pits.

Sediments were removed from the ditch bottom in the segments from the double culverts to the Huntsville Spring Branch. Sediments were moved in leak-protected trucks to the newly constructed landfill. Material was then trucked to the new hazardous waste landfill and deposited in layers of about 1' thickness (18" max), then compacted before additional material is deposited. At the end of each day, impervious plastic sheeting was used to cover the emplaced material so that there will be no exposed DDT residues. When cells of the landfill became ponded from rainfall or by any other means, the water was pumped into a tank truck and emptied into the backwash sump at the DDT water treatment plant.

3. Removal of surface outcroppings from abandoned DDT manufacturing and disposal sites.

Surface outcroppings of DDT at three old disposal sites were scraped up and deposited in the new, hazardous waste landfill in the same manner as described previously. Clay was obtained from nearby knolls and deposited and packed on the scraped surface. Topsoil was then added, dressed, and seeded to prevent erosion. At the old manufacturing site a cattle-type three-strand barbed wire fence with two 16' barbed wire gates were constructed and warning signs affixed.

4. Additional DDT placed in landfill.

Other sources of DDT contaminated soils which were emplaced in the landfill were the sediments from the sump at the Calgon DDT filtration plant and materials disturbed from the old DDT ditch when it was crossed during dirt diversion work. These contaminated soils were placed in the pits using methods previously described.

REFERENCES:

1. Federal Register. "Standards and Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," Vol. 45, No. 98 on Monday, May 19, 1980, Part VII.

2. "Environmental Geology and Hydrology of Huntsville and Madison County, Alabama," Published in 1975 by the Geological Survey of Alabama.

3. Test Report by Testing Incorporated of Decatur, Alabama, 29 August 1978 and 8 January 1979.

4. Federal Register. "U.S. Environmental Protection Agency Rules and Regulations for Hazardous Waste Landfills: 40 CFR Part 265, Subpart F.

5. Standard Methods for the Examination of Water and Wastewater, 14th Edition, 1975.

6. Methods for Chemical Analysis of Water and Wastes, 1974, USEPA Publication.

7. Methods for Chemical Analysis of Water and Wastes, 1979, USEPA Publication.

8. Microbiological Methods for Monitoring Industrial Wastewater, 1973, USEPA Publication.

9. OSHA Safety Regulations as necessary.

10. "Safety Regulations." DARCOM Reg. 385-100.

11. Corps of Engineers General Safety Requirements Manual, EM 385-101.